Comparative vertebrate fauna survey of the Paroo, Cobham and Gumbalara Landsystems in the Western Division of New South Wales

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ABSTRACT

One hundred and thirty-three species of vertebrates were recorded from areas representing three different landsystems on a grazing property on the Paroo River, located 52 kilometres south of Wanaaring in the Western Division of New South Wales. Fauna diversity was highest along the riparian zone of the Paroo River (the Paroo landsystem) and lowest on the red sand plains of the Gumbalara landsystem. The Cobham landsystem, of which the wetland environment of Waitche Lake is an example, gave an intermediate level of species diversity. The Paroo landsystem had the greatest number of small birds, which may have been indicative of the presence of a dense understorey and shrub layer in conjunction with a distinct tree canopy. Overall waterbird abundance and diversity was low due to flood conditions and local rainfall providing ample feeding and nesting areas, thus spreading populations over a greater area. Three threatened species (Brolga, Pink Cockatoo, Yellow-bellied Sheathtail Bat) were recorded as well as a new range extension for the reptile *Lerista xanthura*. Ten species from this survey have not been recorded in the nearby Nocoleche Nature Reserve, indicating the importance of maintaining the wetland environments along the Paroo River in order to conserve regional biodiversity.

Key words: fauna, diversity, vegetation, wetland, landsystems, species.

Introduction

Fauna surveys within the Western Division of New South Wales have characteristically been conducted to sample species diversity at the individual property scale. Results often take the form of species lists for specific areas such as Nocoleche Nature Reserve (NPWS 1989, NPWS Wildlife Atlas 2000), or regenerating mine sites (Halliger 1993). More typically, fauna surveys relate vertebrate species diversity and abundance to the vegetation types present (Henle 1987, Read 1994). Similarly, larger scale surveys have been conducted that relate vertebrate fauna diversity to set geographical areas such as mapsheets (NPWS 1995) or primarily one vegetation type (Bourke Rangelands Liaison Group 1995). More recently, surveys have covered biogeographical regions with results usually aligned to vegetation associations (Mazzer *et al.* 1998, Smith *et al.* 1998).

Currently, land management decisions being made by the Department of Land and Water Conservation, the government authority responsible for administering leasehold land in the Western Division, are being based on a landsystems approach which combines topographical features with soil and vegetation information to delineate discrete mappable units. Landsystem mapping was conducted over the Western Division by the former Soil Conservation Service of New South Wales.

This preliminary fauna survey aimed to sample species diversity on three landsystems present on a single property. Such an approach allows for direct comparison of relative species diversity to the management units utilised by administering bodies. The aim of this study was to utilize this approach so that better informed decisions on land clearing assessments and regional habitat conservation values can be made.

Methods

Location

The grazing property "Gumbalara", 52 km south of Wanaaring, New South Wales, is on the Wanaaring-Wilcannia road. The Paroo River bisects the property in a north-south direction. Total property size is 30814 ha. Three main landsystems have been mapped within the property area. The approximate percentages of the property area covered by each landsystem type being - Paroo (43%), Cobham (1.5%) and Gumbalara (49%).

Survey Timing

Surveys were undertaken over two periods to incorporate seasonal differences (8 - 12 October 1996; 20 - 23 May 1997). An additional observation period was conducted on 18 - 22 June 1998.

Study Area

Landsystem Descriptions from Walker (1991).

a) Paroo Landsystem (Pr) - These are the channels and dunefield islands of the Paroo River. The geomorphology of the type is the present course of the Paroo River which contains a complex system of anastomosing channels, lateral basins and numerous islands of dunefields. These areas are sourced from Quaternary alluvium and aeolian sand.

The lower lying areas are characterised by having grey cracking clays, dense and often impenetrable thickets of River Cooba, Eurah and Lignum with good quality ephemerals after flooding. The islands of red sandy soil are vegetated with open Mulga and Rosewood; bottlewasher and copperburr pastures and locally dense inedible shrub (i.e. woody weeds). The Paroo landsystem has been mapped by the previous Soil Conservation Service of NSW as having an area of 1378 sq. km. Within the property, approximately 13 250 hectares has been mapped under this landsystem.

Four sub-landsystem types were selected for survey representing the main channel of the Paroo River, a distributary channel, an island dunefield and a basin.

Survey Site Location: 215600 E, 6653800 N is a representative site of the landsystem surveyed.

b) Cobham Landsystem (Cb) - These are the salt lakes with fringing dunes and flats in sandy country. Playas, including salinas, claypans and swamp basins form terminal or subterminal basins of major creeks and rivers in sandy country. The area is also characterised by lunettes, best developed on the eastern margins, feeder channels and adjoining alluvial plains. The geology is of mainly saline Quaternary alluvium and aeolian sand. The soils and vegetation are noted as saline clays, brown and grey clays and brown sands. The saline beds are usually bare with claypans, swamp basins and alluvial plains having abundant grasses, chenopods, Canegrass and Lignum. The lunettes are usually vegetated with open Mulga and ephemerals. The Cobham landsystem has been mapped as having an area of 1664 sq. km. Within the property, approximately 462 hectares is mapped under this landsystem.

Waitche Lake and surrounds is the only area on "Gumbalara" designated as being of the Cobham Landsystem. Although it is a relatively large lake covering 462 ha, for the purpose of this survey it was all treated as one site.

Survey Site Location: 211600 E, 6659500 N is a representative site of the landsystem surveyed.

c) Gumbalara Landsystem (Gb) - These are the sandplains with claypans and scattered swamps that are adjacent to the Paroo River. The geomorphology consists of level sandplains to 20 km extent with numerous small claypans, larger swamps and isolated flats of Quaternary alluvail and aeolian soils. The dominant vegetation of this red earth sandy country is open Mulga, areas of dense Belah and a groundcover of bottlewasher and copperburr pastures. The area covered by the Gumbalara landsystem is 865 sq. km. Within the property, approximately 15 099 hectares is mapped under this landsystem.

Only areas representative of the sandplains were surveyed for fauna due to time constraints and adverse weather conditions preventing access to large claypans or swamps. The sandplains, however, occupy the majority of the landsystem area.

Survey Site Location: 218840 E, 6654500 N is a representative site of the landsystem surveyed.

Vegetation

All tree and shrub species were identified from within a 100 metre radius of each selected trapping site. Only the most abundant groundcover species were identified from the same area. Species were collected by randomly traversing the selected search area. No attempt was made to compile a complete vegetation species list for each area. Additional, opportunistic recordings of species were made on other areas of Waitche Lake (which represents all the Cobham landsystem present) and on the adjacent sandplain areas of the Gumbalara landsystem.

Fauna

(a) Pitfall trapping- The location, design and total sampling effort of pitfall traps are given in Table 1.Traps were in place for four consecutive nights and checked twice daily with all fauna identified then released. Each trapline consisted of five, evenly spaced tubes of 15 cm diameter PVC pipe 30 cm deep along a 15 m length of netting.

(b) Small Mammal Trapping - The location, design and total sampling effort of 'Elliott' brand small mammal traps are given in Table 1.Traps were baited with a mixture of peanut butter and rolled oats and set for four consecutive nights. Traps were set in the afternoon and checked and closed the following morning. All fauna were identified then released.

(c) Observation- Bird observations were conducted daily in the early hours of the morning and late afternoon when avian activity is usually at its greatest. Three separate locations were walked within the Paroo Landsystem to cover the various units of this landscape as well as observations being made during the daily checking of the traplines. The shoreline of Waitche Lake was traversed eight times by different observers to cover all available habitat within the Cobham Landsystem. Only two different areas within the Gumbalara landsystem were initially surveyed due to weather constraints, however, a further period of survey was added in which the majority of observation effort was within the Gumbalara landsystem. Incidental observations were recorded at any time provided the landsystem area was known. Only species were recorded, but not number of individuals.

(d) Ground Searches- A minimum of two hours were spent on ground searches for fauna near each trapline position. This included the systematic checking of leaf litter accumulations, logs and brush piles as well as searching in and around any outbuildings and storage dumps. Water and pond edges were also checked for the presence of amphibians.

(e) Bat Trapping / Call Detection- An Anabat II ultrasonic call detector was used over two nights during June 1998 when equipment became available. The detector was positioned adjacent to Waitche Lake, which situated it near the boundary of the Cobham and Gumbalara landsystems. A mist net was set for two nights during the October 1996 survey period between two River Red Gums on the shore of Waitche Lake.

Table 1. Pitfall and small mammal (Elliott brand) trapping effort and design according to landsystem

Landsystem	Feature	Pitfall (P)	Elliott (E)	Sampling Effort
Paroo	Main channel	2 lines	7 traps	140 (P); 60 (E) trapnights
	Distributary channel	2 lines	5 traps	
	Island Dunefield	2 lines	3 traps	
	Basin	1 line	nil	
Cobham	Lake edge	1 line	nil	40 (P); 20 (E) trapnights
	High water/flood level	1 line	5 traps	
Gumbalara	Sandplain	10 lines	20 traps	200 (P); 80 (E) trapnights
	Claypan/swamps	nil	nil	

Results

Vegetation and Soil Habitat Values

The comparison of vegetation and soil habitat values between landsystems is given in Table 2. The areas of highest floristic structural variety and density were found in the riverine and wetland areas (i.e. the Paroo and Cobham landsystems). Tree species on the Paroo and Cobham landsystems were dominated by eucalypts which were absent on the Gumbalara landsystem. The dominant shrub species is Lignum on the cracking grey clays of the riverine and wetland areas whereas Turpentine and other woody weeds are most abundant on the sandy soils of the Gumbalara landsystem.

Fauna

A total survey effort of 9 days of trapping and 14 days of observation identified 133 species on "Gumbalara" (Table 3).

Floristic variety was reflected in associated fauna diversity, with the riverine environment of the Paroo landsystem having 98 species recorded, the wetland habitat of the Cobham landsystem 79 species and the less vegetatively diverse dry country areas of the Gumbalara landsystem had 56 species. The survey period did not coincide with the flowering or seed setting of the abundant shrubs in the Gumbalara land system.

Table 2. Vegetation descriptions according to landsystem.

Landsystem		**Paroo**		**Cobham**	**Gumbalara**
Sub-landsystem	**Main/Dist. Channels**	**Island Dunefield**	**Basin**	**Waitche Lake**	**Sandplain**
Tree Species					
River Red Gum *Eucalyptus camaldulensis*	•	-	-	•	-
River Cooba *Acacia stenophylla*	•	-	-	-	-
Western Coolibah *Eucalyptus coolabah*	•	•	•	-	-
Black Box *Eucalyptus largiflorens*	-	-	•	•	-
Whitewood *Atalaya hemiglauca*	-	-	-	-	•
Leopardwood *Flindersia maculosa*	-	-	-	-	•
Ironwood *Acacia exelsa*	-	-	-	-	•
Mulga *Acacia aneura*	-	-	-	-	•
Shrub Species					
Lignum *Meuhlenbeckia florulenta*	•	-	•	•	-
Emubush *Eremophila longifolia*	-	•	-	-	-
Turpentine *Eremophila sturtii*	-	-	-	-	•
Eurah *Eremophila bignoniflora*	-	-	-	-	•
Harlequin Fuschia-bush *Eremophila duttonii*	-	-	-	-	•
Punty Bush *Cassia eremophila*	-	-	-	-	•
Silver Needlewood *Hakea leucoptera*	-	-	-	-	•
Camel Thorn *Alhagi pseudalhagi*	-	-	-	-	•
Groundcover					
Variable Speargrass *Austrostipa variabilis*	-	-	•	•	-
Canegrass *Eragrostis australasica*	•	-	-	-	-
Warrego Summer Grass *Paspalidium jubiflorum*	-	•	-	•	-
Neverfail *Eragrostis setifolia*	-	-	•	•	•
Fairy Grass *Sporobolus caroli*	-	-	-	-	•
Tall Windmill Grass *Chloris ventricosa*	-	-	-	-	•
Wiregrass sp. *Aristida sp.*	-	-	-	-	•
Wallaby Grass sp. *Austrodanthonia sp.*	-	-	-	-	•
Spiny Flat Sedge *Cyperus gymnocalos*	-	-	-	•	-
Common Nardoo *Marsileaceae drummondi*	•	-	•	•	-
Darling Lily *Crinium flaccidum*	•	-	-	-	-
Erect Yellow Head *Gnephosis foliata*	•	-	-	-	-
Bluebell sp. *Wahlenbergia sp.*	•	-	•	•	-

Desert Sneezeweed *Centipeda thespidioides*	•	-	-	-	-
Rough Raspwort *Haloragis aspera*	•	-	-	-	-
Climbing Saltbush *Einadia nutans*	-	•	-	-	-
Lifesaver Sida *Sida platycalyx*	-	•	-	•	-
Twiggy Sida *Sida intricada*	-	•	-	-	-
Quena *Solanum* esuriale	-	•	-	•	-
Australian Hounds Tongue *Cynoglossum drummondi*	-	•	-	-	-
Green Copperburr *Sclerolaena decurrens*	-	-	-	-	•
Goathead Burr *Sclerolaena bicornis*	-	-	-	-	•
Velvet Potato-bush *Solanum ellipticum*	-	-	-	-	•
% Groundcover	<10	10-40	35	40-60	<5
Soils					
Grey clays	•	-	•	•	-
Sands	-	•	-	-	•
No surface cracking	-	•	•	•	•
Minor surface cracking	•	-	-	-	-
Sinkholes common	-	-	•	•	-

Table 3. Fauna list for landsystem types recorded on "Gumbalara". • = present ; - = not present

Species	**Landsystems**		
Amphibians	**Paroo**	**Cobham**	**Gumbalara**
Crinia deserticola	-	•	-
Eastern Froglet *Crinia parasignifera*	-	•	-
Red Groined Toadlet *Uperolia rugosa*	•	•	•
Desert Tree Frog *Litoria rubella*	•	•	•
Perons Tree Frog *Litoria peronii*	-	-	•
Long-thumbed Frog *Lymnodynastes fletcheri*	•	•	•
Spotted Grass Frog *Lymnodynastes tasmaniensis*	•	•	•
Waterholding Frog *Cyclorana platycephala*	-	-	•
Crucifix Toad *Notaden bennetti*	-	-	•
Painted Burrowing Frog *Neobatrachus sudelli*	-	-	•
Reptiles			
Prickly Gecko *Heteronotia binoei*	•	•	•
Tree Dtella *Gehyra variegata*	-	•	•
Dwarf Skink *Menetia greyii*	•	•	-
Boulenger's Skink *Morethia boulengeri*	•	•	•
Wood Mulch Slider *Lerista meulleri*	•	-	-
Lerista xanthura	•	-	-
Ctenotus Skink *Ctenotus regius*	•	-	•
Ctenotus Skink *Ctenotus leonhardii*	-	-	•
Central Bearded Dragon *Pogona vitticeps*	-	•	•
Central Netted Dragon *Ctenophorus nuchalis*	-	-	•
Eastern Blue-tongue Lizard *Tiliqua scincoides*	•	-	•
Shingleback *Trachydosaurus rugosus*	•	•	•
Black-headed Monitor *Varanus tristus ssp tristis*	•	-	-
Blind Snake *Ramphotyphlops bituberculata*	•	-	-
Western Brown Snake *Pseudonaja nuchalis*	-	•	-
Mulga Snake *Pseudechis australis*	-	•	-
Carpet Python *Morelia spilota ssp. variegata*	-	•	-
Murray Turtle *Emydura macquarri*	-	•	-
Mammals			
Eastern Grey Kangaroo *Macropus giganteus*	•	•	-
Western Grey Kangaroo *Macropus fuliginosus*	•	•	-

Red Kangaroo *Macropus rufus*	•	-	-
Echidna *Tachyglossus aculeatus*	•	-	-
Fat-tailed Dunnart *Sminthopsis crassicaudata*	•	-	-
Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*	-	-	•
Lesser Long-eared Bat *Nyctophilus geoffroyi*	-	-	•
White-striped Freetail Bat *Tadarida australis*	-	-	•
Inland Freetail Bat *Mormopterus planiceps* - small penis form	-	-	•
House Mouse *Mus musculus*	•	-	-
Brown Hare *Lepus capensis*	•	-	-
Rabbit *Oryctolagus cuniculus*	•	•	•
Fox *Vulpes vulpes*	•	•	•
Feral Cat *Felis catus*	•	•	-
Feral Goat *Capra hircus*	•	•	•
Feral Pig *Sus scrofa*	•	•	•
Camel *Camelus dromedarius*	•	-	•
Birds			
Emu *Dromaius novaehollandiae*	•	•	•
Australian Pelican *Pelecanus conspicillatus*	•	•	-
Darter *Anhinga melanogaster*	-	•	-
Pacific (White-necked) Heron *Ardea pacifica*	•	•	-
White-faced Heron *Ardea novaehollandiae*	•	-	-
Sacred Ibis *Threskiornis aethiopica*	•	•	-
Straw-necked Ibis *Threskiornis spinicollis*	•	-	-
Royal Spoonbill *Platalea regia*	•	•	-
Yellow-billed Spoonbill *Platalea flavipes*	•	•	-
Black Swan *Cygnus atratus*	-	•	-
Pacific Black Duck *Anas superciliosa*	-	•	-
Maned (Wood) Duck *Chenonetta jubata*	-	•	-
Musk Duck *Biziura lobata*	-	•	-
Black Kite *Milvus migrans*	-	•	-
Whistling Kite *Milvus sphenurus*	•	•	-
Wedgetail Eagle *Aquila audax*	•	-	•
Swamp Harrier *Circus approximans*	-	•	-
Peregrine Falcon *Falco peregrinus*	-	•	-
Brown Falcon *Falco berigora*	•	-	-
Australian Hobby *Falco longipennis*	•	-	•
Stubble Quail *Coturnix pectoralis*	•	-	-
Black-tailed Native Hen *Gallinula ventralis*	•	-	-
Purple Swamphen *Porphyrio porphyrio*	•	-	-
Eurasian Coot *Fulica atra*	-	•	-
Brolga *Grus rubicundus*	•	•	-
Masked Lapwing *Vanellus miles*	•	•	-
Black-fronted Plover *Charadrius melanops*	•	•	-
Black-winged Stilt *Himantopus himantopus*	-	•	-
Whiskered (Marsh) Tern *Chlidonias hybrida*	-	•	-
Peaceful Dove *Geopelia placida*	•	•	-
Diamond Dove *Geopelia cuneata*	-	•	-
Common Bronzewing *Phaps chalcoptera*	•	•	•
Crested Pigeon *Geophaps lophotes*	•	•	•
Galah *Cacatua roseicapilla*	•	•	•
Little Corella *Cacatua pastinator*	-	•	-
Pink Cockatoo *Cacatua leadbeateri*	-	•	•

Cockateil *Leptolophus hollandicus*	•	•	•
Budgerigar *Melopsittacus undulatus*	•	•	-
Mallee Ringneck *Barnardius barnardi*	•	•	•
Mulga Parrot *Psephotus varius*	•	•	•
Blue Bonnet *Northiella haematogaster*	•	•	•
Pallid Cuckoo *Cuculus pallidus*	-	-	•
Tawny Frogmouth *Podargus strigoides*	-	•	-
Laughing Kookaburra *Dacelo novaeguineae*	-	•	-
Red-backed Kingfisher *Halcyon pyrrhopygia*	•	-	-
Sacred Kingfisher *Todirhampus sancta*	•	-	-
Rainbow Bee-eater *Merops ornatus*	•	•	-
Welcome Swallow *Hirundo neoxena*	-	-	•
Tree Martin *Hirundo nigricens*	-	•	-
Fairy Martin *Hirundo ariel*	•	-	-
Richards Pipit *Anthus novaeseelandiae*	•	-	-
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	•	•	-
White-winged Triller *Lalage tricolor*	-	-	•
Red-capped Robin *Petroica goodenovii*	•	-	•
Jacky Winter *Microeca leucophaea*	•	-	•
Rufous Whistler *Pachycephala rufiventris*	•	-	-
Grey Shrike-thrush *Colluricincla harmonica*	•	-	•
Grey Fantail *Rhipidura fuliginosa*	•	-	-
Willie Wagtail *Rhipidura leucophrys*	•	•	•
Chirruping Wedgebill *Psophodes cristatus*	•	-	-
White-browed Babbler *Pomatostomus superciliosus*	•	-	-
Chestnut-crowned Babbler *Pomatostomus ruficeps*	•	•	•
Variegated Fairy-wren *Malurus lamberti*	•	•	•
White-winged Fairy-wren *Malurus leucopterus*	•	-	-
Chestnut-rumped Thornbill *Acanthiza uropygialis*	-	-	•
Southern Whiteface *Aphelocephala leucopsis*	-	-	•
Brown Treecreeper *Climacteris picumnus*	•	•	-
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*	•	•	-
Little Friarbird *Philemon citreogularis*	•	-	-
Blue-faced Honeyeater *Entomyzon cyanotis*	-	•	-
Yellow-throated Miner *Manorina flavigula*	•	•	-
Singing Honeyeater *Lichenostomus virescens*	-	-	•
White-plumed Honeyeater *Lichenostomus penicillatus*	•	•	-
White-fronted Honeyeater *Phylidonyris albifrons*	•	-	•
Striated Pardalote *Pardalotus striatus*	•	•	•
Zebra Finch *Taeniopygia guttata*	•	-	•
Spotted Bowerbird *Chlamydera maculata*	-	•	-
White-winged Chough *Corcorax melanorhamphos*	•	•	-
Apostlebird *Struthidea cinerea*	•	•	•
Australian Magpie-lark *Grallina cyanoleuca*	•	•	-
White-breasted Woodswallow *Artamus leucorhynchus*	-	•	-
Masked Woodswallow *Artamus personatus*	•	-	•
White-browed Woodswallow *Artamus superciliosus*	•	•	-
Black-faced Woodswallow *Artamus cinereus*	-	-	•
Grey Butcherbird *Cracticus torquatus*	•	•	-
Pied Butcherbird *Cracticus nigrogularis*	•	•	•
Australian Magpie *Gymnorhina tibicen*	•	•	-
Australian Raven *Corvus coronoides*	•	•	-

The majority of fauna species was recorded from observation and ground searches rather than by trapping. Only one species (Shingleback) was captured in the small mammal traps in 160 trap-nights. A total of 45 captures from 13 species were made in the pitfall traps over the two survey periods. Nine species (three amphibians, five reptiles and one mammal) were captured in pitfalls in the October survey while seven species (six amphibians, one reptile) were recorded during the cooler month of May. The high incidence of amphibians captured in the May survey reflected rainfall before and during the survey period. The relative lack of reptile captures could be due to the cooler temperatures restricting movement and hence the potential for capture. The second survey recorded four species that were not trapped in the initial October survey. Five species (Crucifix Toad *Notaden bennetti*, Sudells Frog *Neobatrachus sudelli*, Fat-tailed Dunnart *Sminthopsis crassicaudata*, the skink *Ctenotus regius*, and the blind snake *Ramphotyphlops bituberculata*) that were trapped in the surveys were not recorded by subsequent observation or ground searches.

Four bat species were recorded during the survey. The White-striped Freetail Bat *Tadarida australis*, Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* and Inland Freetail Bat *Mormopterus planiceps* - small penis form were identified from an analysis of ultrasonic calls by a recognised consultant in the field (Glenn Hoye - Fly By Night Bat Surveys Pty. Ltd.). A single Lesser Long-eared Bat *Nyctophilus geoffroyi* was found inside the shearer's quarters of the property which is located on the Gumbalara landsystem but adjacent to Waitche Lake. Mist netting on the lake edge provided no captures.

Species of Conservation Concern

From this survey two bird species, the Pink Cockatoo *Cacatua leadbeateri* and the Brolga *Grus rubicundus*, and one bat species (Yellow-bellied Sheathtail Bat) were recorded, which are listed as threatened species under the *Threatened Species Conservation Act 1995*. Two Brolgas were seen on the edge of flooded lignum on a tributary of the Paroo River. This area had dense lignum with patches of damp ground and water in small channels and depressions. Groundcover at this site was noted to be mainly Darling Lily, Bluebells and Onion Grass. Frogs, a possible food source, were also noted as plentiful. Four more Brolgas were observed around the bottom end of Waitche Lake where the water flows out and into an area of scattered lignum. Brolgas in pairs or small groups were observed both along the Paroo River and at Waitche Lake on each survey period (October, May, June), indicating long-term use of the area by this species.

Two Pink Cockatoos were seen on a red sand ridge, one in a large Whitewood (12 m) and the other on the ground in a small patch of grass. The sand ridge vegetation was dominated by Emu-bushes, Hopbushes, Turpentine, Wilga and Budda. A second pair of cockatoos were seen adjacent to a swamp coming off the top end of Waitche Lake. This area had Black Box and Western Coolibah around its edge. Red sand plain country comes right up to the trees on the edge of the swamp. These birds were most likely feeding on grasses growing beside the track.

Calls identified as those of the Yellow-bellied Sheathtail Bat were recorded by a hand-held Anabat II ultrasonic call detector positioned within the sand plain Gumbalara landsystem, but only some 300 metres from the edge of Waitche Lake. It was noted that most bats came into detector range from the west, away from the lake and well within the Gumbalara landsystem type.

Two amphibian and three reptile species are listed by Sadlier *et al.* (1996) as being of particular conservation concern in the western division of NSW. *Crinia deserticola* is listed as rare at the state level with records in the western division from only four sites south of Wanaaring on the Paroo River. The survey area is within the known distribution of this species. The Eastern Froglet *Crinia parinsignifera* is described as rare within the western division but has been recorded from the nearby Nocoleche Nature Reserve as well as the survey area. The slider, *Lerista xanthura*, is of conservation concern due to its apparent disjunct population within the western division. The record from this survey lies roughly halfway between known locations and may well represent a range extension. Swan (1990) and Cogger (1992) note this species to be at or past the eastern limit of its known distribution in the general survey region. The Murray Turtle *Emydura macquarii* is also noted as being of conservation concern due to the insufficient amount of data known on its distribution and habitats. The Carpet Python *Morelia spilota* ssp. *variegata* is also listed as being insufficiently known in the western division and may be possibly endangered. Two individuals were recorded sunning on limbs of dead trees along the shore of Waitche Lake.

Four bird species recorded in this survey, the Whiskered Tern, Australian Pelican, Darter and the Royal Spoonbill are listed by Smith *et al.* (1995) as having a restricted breeding distribution in the western division of NSW. No mammals recorded in this survey are regarded as of conservation concern in the western division (Dickman 1994). The Yellow-bellied Sheathtail Bat is listed as a species of national significance due to having either a restricted national distribution or being rare or very sparse throughout its geographical range. However, this species, along with all bat species, do not appear to be in decline within the western division (Dickman 1994).

Discussion

Survey limitations

In this study, the seasonality of survey periods, equipment availability and weather constraints prevented a more efficient fauna survey from being undertaken. Three main areas of survey deficiency were noted. First, survey effort was low on the main landsystem type present on the property. While pit trapping was conducted, corresponding bird observation periods and ground searches for reptiles were not detailed. An attempt was made to redress this survey effort imbalance with additional observation periods during a third visit to the property in June 1998. Second, the level of small mammal trapping was generally insufficient to capture species that have very low trappability rates. Third, no attempt was made to survey the bat fauna of all the representative landsystems, especially during the warmer months when bat activity would be at its peak. Fourth, no spotlight searches or playback call surveys were made on any landsystem in order to ascertain nocturnal fauna levels. Thus, more species are certain to be added to this list in any future survey work. Additional survey work would be required to ascertain whether species diversity between landsystems reflected vegetational changes or just reflect differences in survey effort on each landsystem.

Species diversity according to landsystem

Despite survey limitations, a total of 133 species were recorded, consisting of 88 birds, 17 mammals, 18 reptiles and 10 amphibians. Of these, 17 species (4 amphibians, 2 reptiles, 4 mammals, 7 birds) were recorded solely on the red country of the Gumbalara landsystem. Three of the four amphibians were burrowing species, the other was a tree frog. No burrowing amphibians were recorded on the riparian and wetland areas of the Paroo and Cobham landsystems. The reptile species (the skink *Ctenotus leonhardii*, Central Netted Dragon) were those more likely to inhabit the drier sand dunes rather than heavy clay soils subject to periodic flooding. The four mammal species recorded only on the Gumbalara landsystem were bats, which reflected the placement of the detector rather than the species actual distribution. It is expected that most bat species present would range over a wide area and come to water points within the other landsystems. Two of the seven bird species noted only on the Gumbalara landsystem were woodswallows, which may specialise in these more open woodland / shrubland habitats.

A comparison of the remaining 116 species present on the Paroo and Cobham landsystems shows that only 23% were recorded on both areas. The breakdown of these riparian generalist species shows 0/10 (0%) amphibians, 1/18 (6%) reptiles, 3/17 (18%) mammals and 22/88 (25%) birds. This may indicate that certain species are more confined to the perennial lake system of the Cobham landsystem, while others are more likely to be found along the permanent riparian zone of the Paroo River. The Paroo landsystem vegetation differed significantly from that of the Cobham landsystem site. The Paroo had significant stands of Lignum and River Cooba, which was virtually absent at the Cobham site. Therefore, one would expect shrub dwelling fauna to be present on the Paroo and less abundant on the Cobham site. For example, bird species found only in the Paroo landsystem included the Rufous Whistler, Grey Fantail, White-browed Babbler, Red-backed Kingfisher, Sacred Kingfisher, White-winged Fairy-wren, Black-tailed Native Hen, Purple Swamphen and Chirruping Wedgebill. Most rely on dense shrub/vegetation cover as critical habitat. Both sites had River Red Gum lining the water's edge, but differed in their secondary tree species being mainly Western Coolibah at the Paroo site and Black Box at the Cobham Site.

The majority of species recorded only on Waitche Lake (Cobham landsystem) were waterbirds such as the Darter, White-faced Heron, Black-winged Stilt, Eurasian Coot, Musk Duck, Maned Duck, Pacific Black Duck and Black Swan. These species may be limited to the large open expanses of water and shallow shorelines rather than the more enclosed, densely vegetated sections of the Paroo River. The birds of prey noted only on the lake area were the Peregrine Falcon, Swamp Harrier and Black Kite. It is noteable that the amphibians recorded solely on the Cobham landsystem of Waitche Lake were the two species of *Crinia* (*C. deserticola*, *C. parasignifera*).

A high number of amphibians, both in species diversity and in abundance, were found in what is essentially a dry environment on the Gumbalara landsystem. Burrowing frogs were expected to utilise the sandy soils as digging is easy and soil moisture is available in dry times. However, the presence of several species of tree frog, and grass frogs more associated with wetlands, at significant distances from any permanent water, was notable. These amphibians presumably live in the shrubs or grass patches in depressions throughout the landsystem as there are only scattered trees that are large enough to provide hollows and the red soil does not crack to give any amphibian refuge areas. The majority of survey time on the property was linked to recent rainfall thus providing optimum conditions for amphibian breeding and capture.

There was a relative lack of waterbird species on both wetland landsystems. This most likely is a function of the large areas of water present in the region as the Paroo River was in flood, Waitche Lake was full and recent rains in the area had also filled many claypans and depressions over the whole property. Therefore, waterbirds had dispersed over the region to take advantage of this situation. Kingsford *et al.* (1994), in their surveys of the Waitche Lake, recorded up to 30 waterbird species and has described this wetland as having a suite of species typical of freshwater ecosystems. Waterbird species recorded as breeding on Waitche Lake were Black Swan, Yellow-billed Spoonbill, Royal Spoonbill, Pacific Heron, White-faced Heron, Darter and Pacific Black Duck, while the river maintains a population of Brolga over most months of the year. Black-tailed Native Hen were recorded along the Paroo River in all survey periods. While surveys in October 1996 and May 1997 recorded relatively low numbers of these birds, in June 1998 there were several thousand birds present all along the river, often in flocks of between 100-200 birds. All three survey periods co-incided with minor flood levels along the Paroo River.

Fauna species comparison to nearest conservation reserve

The fauna recorded in this study (133 species) compared to the fauna list compiled from Nocoleche Nature Reserve (246 species) is shown in Table 4. Nocoleche Nature Reserve also lies on the Paroo River some 20 kilometres upstream from Gumbalara, and incorporates all landsystems present on the property. Several more mammal species are expected to be added to the Gumbalara study area, particularly bats. Both fauna lists recorded only one dasyurid, the Fat-tailed Dunnart, which may indicate that it is the only species present in the locality or more likely, that insufficient survey work of available microhabitats has been conducted. The large differences in the number of bird species comes mainly from the number of waterbirds noted on the Nature Reserve (52 species) compared to a relative paucity for the duration of our study (17 species). This is probably a function of waterbird dispersal with floodwater plus the timing of our survey not co-inciding with any waterbird

Table 4. Fauna Species Comparison – Gumbalara / Nocoleche Nature Reserve.

Species	Gumbalara	Nocoleche
Amphibians	10	14
Reptiles	18	36
Mammals	17	23
Birds	88	173
Total	**133**	**246**

Table 5. Fauna species recorded from Gumbalara but not listed as present on nearby Nocoleche Nature Reserve.

Red Groined Toadlet *Uperolia rugosa*
Dwarf Skink *Menetia greyii*
Lerista xanthura
Wood Mulch Slider *Lerista meulleri*
Echidna *Tachyglossus aculeatus*
Inland Freetail Bat *Mormopterus planiceps* - small penis form
Hare *Lepus capensis*
Camel *Camelus dromedarius*
Stubble Quail *Coturnix pectoralis*
Purple Swamphen *Porphyrio porphyrio*

breeding events. With reptiles, our survey recorded 18 species compared to 36 for Nocoleche with cold weather and rain periods limiting opportunities for trapping and extensive reptile searches.

Ten species were recorded from this survey that have not been recorded on Nocoleche Nature Reserve (Table 5). Nine were noted from the riparian and wetland areas on Gumbalara and it would be presumed that these habitats also exist to some degree on the nearby Nature Reserve.

Importance of wetland environments

The recognition of the importance of wetland environments in north-western New South Wales (which incorporates the Paroo and Cobham landsystems) is given in Kingsford *et al.* (1994) when they state that with regard to waterbirds " The catchment is the most critical conservation issue for wetland and waterbird conservation. The integrity of the hydrology which provides water to these wetlands, with all its variability, must remain intact and unless protected is unlikely to adequately conserve a wetland for waterbirds and the other aquatic fauna."

"These rivers [Bulloo, Paroo, Warrego] remain among the few in the state that have not been affected by irrigation and they should remain that way. The downstream wetlands are highly valuable for conservation and traditional pastoral activities. They should be recognised for these values."

Observations made during this study indicate that the Paroo River and Waitche Lake environments have a high diversity of vertebrate fauna and, in dry times, may be important for waterbird species. The maintenance of the wetland environments along the Paroo River (i.e. Paroo and Cobham landsystems) is critical in order to conserve the existing bidiversity of the region.

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